

## *Zn and Cu Levels in the Eastern Oyster, Crassostrea virginica, From the Lower James River*

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### ABSTRACT

Levels of Zn and Cu in shucked, whole bodies of the oyster *Crassostrea virginica* ranged up to 10,000 ppm Zn and 584 ppm Cu, with levels averaging 3915 ppm Zn and 180 ppm Cu. These levels are near the upper limits of values previously reported for the species and are considerably higher than levels reported in a previous survey of the same area. The data may indicate increased Zn contamination of lower James River oysters over the period 1971-1973.

Live oysters were collected on 27 June 1973 from a rock retaining wall along Craney Island, a large man-made peninsula extending into the lower James River (Fig. 1). After shucking, the oyster body was dried to a constant weight at 105° C. and digested using nitric and perchloric acids (Baumhardt and Welch, 1972; Anderson, 1972). Zn and Cu concentrations were determined using atomic absorption spectrophotometry and results are expressed on the basis of  $\mu\text{gm}$  metal/gm dry oyster tissue. A total of 104 oysters was sampled. These were pooled in order to provide sufficient material for analysis, yielding 50 pairs of Zn and Cu concentrations (Fig. 2).

As a check on analytical procedure, replicate samples of standard bovine liver were carried through the entire digestion analysis procedure. Results of these determinations, shown in Table 1, indicate generally good agreement with the prescribed National Bureau of Standards

values. The fact that observed levels were slightly below the prescribed concentrations may mean that levels recorded for the oysters may be slight underestimates.

### Discussion

The bioaccumulation of heavy metals, especially Zn and Cu, by *Crassostrea virginica* has been well documented (Hiltner and Wichmann, 1919; Hunter and Harrison, 1928; McFarren *et al.*, 1962; Galtsoff, 1964; Pringle *et al.*, 1968; Shuster and Pringle, 1969; Kopfler and Moyer, 1969; Pequegnot *et al.*, 1969; Wolfe, 1970; Windom and Smith, 1972; and Bender *et al.*, 1972).

In their survey of Virginia estuaries, including the area sampled in this study, Bender *et al.* (1972) advanced a linear relationship between Zn and Cu content in oysters from areas without unnatural inputs of either of the metals. A 95%



Fig. 1. Crane Island study site, lower James River.

confidence band about this least squares regression line ( $Y = 1.9 + 0.09X$ ) was described by  $Y = -33 + 0.07X$  and  $Y = +30 + 0.11X$ . Points lying either below or above this confidence band indicate unnatural contamination of oysters by Zn or Cu, respectively. Zn and Cu levels in oysters from this study are described by the equation  $Y = -31 + 0.05X$ , indicating increased Zn contamination (Fig. 3).

Several factors may be advanced to

Table 1. Analysis of standard bovine liver.

	Zn (ppm)	Cu (ppm)
National Bureau of Standards	$130 \pm 10$	$193 \pm 10$
This study	$108 \pm 6.0$	$180 \pm 5.0$

explain the observed increase in Zn levels in lower James River oysters over the period 1971 to 1973. First, the chemical methods utilized to digest the oyster tissue differed slightly. Bender *et al.* (1972) employed a nitric acid process, while I used a nitric and perchloric acid digestion. Secondly, part of the increase in Zn levels might be ascribed to seasonal changes in the elemental composition of the oyster (Galtsoff, 1953). Bender *et al.* collected oyster samples from February to March, while I sampled in June. Thirdly, the study by Bender *et al.*, being a survey report of

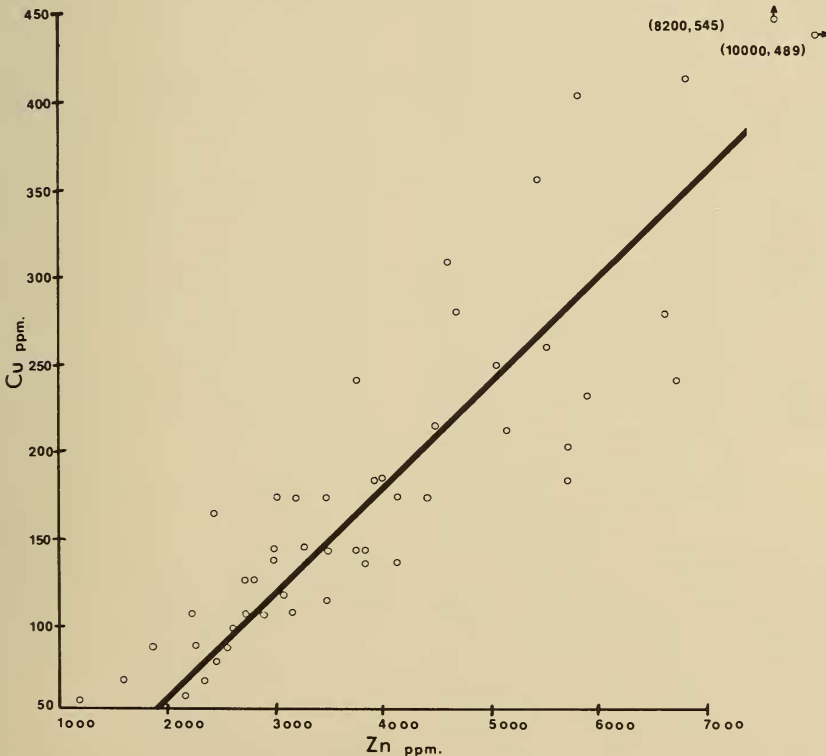


Fig. 2. Relationship between zinc and copper in oysters from the lower James River.

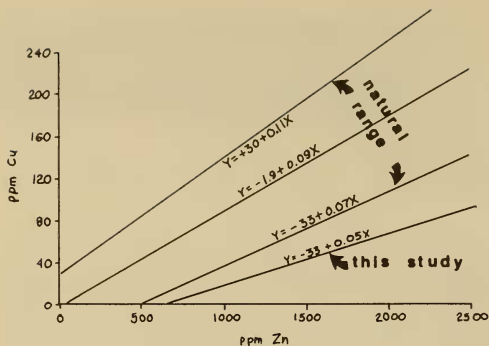


Fig. 3. Oyster data indicating Zn contamination, after Bender, Huggett, and Slone (1972). The natural range represents the 95% confidence interval for Zn and Cu levels in oysters from uncontaminated Virginia estuaries.

general conditions in several Virginia estuaries, may not have had sampling points dense enough to detect this local area of higher contamination. Lastly, the difference between the Zn levels reported for 1971 and those observed in 1973 may reflect a real increase in Zn pollution of this waterway.

#### Summary

A survey of Zn and Cu in oysters inhabiting the lower James River was conducted and results of the analysis compared to a previous survey of the same area. A substantial increase in Zn content of the oysters was observed over the 2-1/2 year period between the studies. An increase in the Zn contamination of the waters and/or seasonal variation in the elemental composition of the oyster are probable causes.

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